

**Amendments to the Specification:**

Please replace paragraph [0002] with the following amended paragraph:

**[0002]** The subject invention relates to the problem of providing a robust, compact characterization of a block of printed text which will distinguish the selected block of text from other such blocks. More particularly, it relates to the problem of providing an image-based characterization of a printed address block which can be incorporated into a digital postal indicium. (By "robust and compact" herein is meant information which is small enough in quantity to be incorporated into postal indicia yet will identify a text block, and distinguish it from other text blocks, with sufficient reliability to deter "rubber stamp" counterfeiting; despite errors introduced by the printing and/or scanning processes.) In other words the robustness of an image based characterization of a printed address block is determined by a number of salient features of (descriptors) that are invariant to various defects and imperfections in introduced as a result of printing the address block and its subsequent scanning and conversion to a digital image. The invariant in this context means that the characterizations is not effected by the aforementioned defects and thus remains the same regardless of all practical encountered defects and deformations.

Please replace paragraph [0004] with the following amended paragraph:

**[0004]** Digital postal indicia using encryption technologies are extremely secure. In general, without knowledge of the proper encryption keys, it is essentially impossible to

produce a counterfeit digital indicium. However, digital indicia are subject, as are all postal indicia, to "rubber-stamp" counterfeiting when a valid indicium is scanned and reproduced on multiple mail pieces. To prevent such "rubber-stamp" counterfeiting, it is known to incorporate information from the destination address block of the mail piece into the postal indicium to create a practically unique indicia. ~~Because space on an envelope in the indicia is~~ limited, typically only a small portion of the information in the address block will be incorporated into the indicium.

Please replace paragraph [0007] with the following amended paragraph:

**[0007]** The above object is achieved and the disadvantages of the prior art are overcome in accordance with the subject invention by a method and system for generating characterizing information for a selected block of printed material (such as an address printed on an envelope or other mail piece), in which said printed material is to be scanned from an object and compared with said characterizing information at a location distant from where said block is printed. In the text below the characterizing information for the block of printed material is defined as a set of salient features (descriptors) of said image that is invariant with regard to the defects and imperfections that are introduced as a result of printing of the text at a mailpiece and scanning/converting the print image into a digital image. The system of the subject invention is controlled in accordance with the method to: a) print said block on an object (mailpiece); b) determine estimates of robustness for each algorithm in a predetermined set of algorithms; and c) select, as a function of said estimates, a combination

of descriptors generated by a corresponding combination of said algorithms as said characterizing information.

Please replace paragraph [0008] with the following amended paragraph:

**[0008]** In accordance with one aspect of the subject invention the estimates are determined by: a) filtering a pristine digital image (digital image formed by a computer before sending it to a printer for printing) of said block of printed material with a print/scan filter to create a filtered image, said print/scan filter simulating the expected transformation of said pristine image by printing and scanning processes; b) applying each algorithm from said predetermined set of characterizing algorithms to said filtered image to generate a plurality of corresponding second characterizing information descriptors for said filtered digital image; and c) for each algorithm from said predetermined set of characterizing algorithms, comparing corresponding said first and said second descriptors to determine said estimates of robustness. The descriptors that are determined to be robust are those that remain invariant after application of them to said filtered digital image.

Please replace paragraph [0009] with the following amended paragraph:

**[0009]** In accordance with another aspect of the subject invention the estimates are determined by: a) filtering a pristine digital image of said block of printed material with a print/scan filter to create a filtered image, said print/scan filter simulating the expected transformation of said pristine image by printing and scanning processes; b) further filtering

said filtered image with one or more defacing filters, said defacing filters simulating ~~simulate~~ blots, smudges, failure of print elements or ~~scanner-scanning (in order to take into account~~ variety of defects and imperfections that were not simulated by printing and scanning process ~~filter)~~ sensors, or other, similar occasional events which can not easily be incorporated into said print/scan filter to create one or more defaced images; c) applying each algorithm from said predetermined set of characterizing algorithms (designed to compute salient features/descriptors of the digital image) to said filtered image and to said one or more defaced images to generate a plurality of corresponding second characterizing information descriptors for said filtered digital image and one or more pluralities of defaced image descriptors corresponding to each of said one or more defaced images; and d) for each algorithm from said predetermined set of characterizing algorithms, comparing corresponding first characterizing information descriptors with corresponding second characterizing information descriptors and with each of said one or more corresponding defaced image descriptors to determine said estimates of robustness.

Please replace paragraph [0015] with the following amended paragraph:

**[0015.1]** Figure 2 shows a schematic block diagram of a mailing system and a verification system in accordance with the subject invention.

Please add the following paragraph ad [0015.2]

**[0015.2]** Figure 3A shows a pristine and filtered digital images.

Please replace paragraph [00024] with the following amended paragraph:

**[0024]** In Figure 2, mailing system 22 includes address printer controller 13, address printer 14, postage meter 16, and indicia printer 20, which are substantially similar to the corresponding prior art elements shown in Figure 1. System 22 differs in including data stores 21 and 23 communicating with controller 13 ~~and for the purpose of storing in the manner in which controller 13 generates characterizing information produced by controller 13.~~ ~~Data.~~ Thus, data store 21 stores a plurality ~~(inventory)~~ of characterizing algorithms, as will be described further below, and data store 23 stores at least a print/scan filter which, when applied to the pristine ~~digital~~ image generates a filtered image which approximates the transformation of the pristine image by the printing and scanning processes. In other embodiments, data store 26 stores one or more defacing filters which simulate blots, smudges, failure of print elements or scanner sensors, or other, similar ~~occasional events/defects~~ which can not easily be incorporated into said print/scan filter to create one or more defaced images. Together, meter 16, printer 20, form secure postal indicia printing system 22.

Please replace paragraph [0025] with the following amended paragraph:

**[0025]** Figure 2 also shows verification controller 25, camera 27, data store 28, storing ~~the characterizing inventory~~ of characterizing algorithms used in system 22, and diverter 29; which together comprise verification system 30 for comparing address block A with information recovered from indicium IN and diverting mail pieces which do not match, as described above. (System 30 is typically located at a postal facility distant from system 22.)

Except as to programming of controller 25 to carry out the comparison algorithm of the subject invention, as will be described further below, operation of verification system 30 is substantially conventional and need not be described further here for an understanding of the subject invention.

Please replace paragraph [0026] with the following amended paragraph:

**[0026]** Three methods for generation of image-based characterizing information which are believed to provide improved compactness and robustness in accordance with the above object of the invention, have recently been developed by the assignee of the present application and are described below as illustrative of the type of characterizing algorithms which can be used with the subject invention. Numerous other algorithms will be apparent to those skilled in the art and particular choices of algorithms to be used form no part of the subject invention, except as may be recited in the claims below and equivalents.

Please replace paragraph [0027] with the following amended paragraph:

**[0027]** Fig. 3A shows a pristine and pristine and filtered digital images. A pristine image is shown at 50 and a filtered image is shown at 51. In line 52 the line is skewed. At 53 pixels are missing from numeral "0" and additional black pixels are shown in upper case letter "C" At 54 the entire horizontal line of black pixels is missing. A characterizing algorithm where the characterizing information comprises measurements of the lengths of the individual words which make up address A, is shown in Figure 3B. Address block A is parsed to identify individual words by first identifying line spaces ~~48-51~~ by determining the occurrence of

large amounts of ~~horizontal-vertical~~ white space between ~~blocks-lines~~ of printed text, and then identifying word spaces  $ws$  by determining the occurrence of large amounts of ~~vertical~~ ~~horizontal~~ white space between ~~consecutive~~ blocks of printed text (as shown with respect the first line of address A). Word lengths ~~4-11~~ through ~~19-19~~ are then determined for address A. Preferably, word lengths are taken (measured in pixels) from the edges of word spaces  $ws$  (or the address edges) as shown, but can be taken in any convenient manner, such as along the midline of the words.

Please replace paragraph [0028] with the following amended paragraph:

**[0028]** ~~It is believed that using four or fewer bits per word would not be useful in postal applications. Thus, in a preferred embodiment, the number of bits used can be selected to encode all the length of words in the address, and two control bits will be sufficient to indicate selection of five to eight bits per word to encode the length of the word. In other embodiments, a fixed number of words in the address, for example the first eight, can be scanned at a fixed number of bits per word; eight in this case, since control bits would not be needed to specify the number of bits per word.~~

Please replace paragraph [0029] with the following amended paragraph:

**[0029]** Another algorithm, where the characterizing information comprises measurements of the number of "outliers" in each word (or each line) which make up address A, is shown in Figure 4. (By "outliers" herein is meant ascenders or descenders and portions of capitals of which that project beyond thresholds, which are preferably determined by the

upper and lower bounds of lower case letters without ascenders or descenders, such as "a", "c", "e", etc.) Address A is parsed to identify individual words, if necessary, by first identifying line spaces ls-l\_s by determining the occurrence of large amounts of horizontal white space between blocks of printed text, and then identifying word spaces ws by determining the occurrence of large amounts of vertical white space between blocks of printed text (as shown with respect the first line of address A). Otherwise only the lines need be identified. Fig. 4 shows at line 40, a line that defines the upper boundary of a lower case characters in line l of the address block (Danny A. Lellis. At line 42 is shown the lower boundary of the lower case characters in the same line of the address A. Ascenders of the text in line l are shown at 34 and 36 (character A and L and ll). The descenders are shown at 41.

Please replace paragraph [0034] with the following amended paragraph:

**[0034]** Bit streams such as those describe above comprise ordered sequences of values which are typically, though not necessarily, numeric values associated with words in the address block. (Such bit streams are called hereinafter ~~sometimes~~ "characterizing information descriptors" or "descriptors" and such values are hereinafter ~~sometimes~~ "characterizations".) As described above, when an indicium is validated, i.e., tied to the mail piece on which it is printed, at a distant postal facility the descriptor generated from the pristine image and incorporated into the indicium is compared with a descriptor recovered from an image scanned from the address block printed on the mail piece. It will be apparent to those skilled in the art that the recovered image will be transformed with respect to the pristine image by the characteristics of the printing and scanning processes, as well as



possibly by the occurrence of occasional ~~events-defects~~ such as blots. Thus, it is important that the algorithm used to characterize the address block be robust; that is that it produces descriptors that match sufficiently when an indicium is valid, and do not match for invalid indicia, despite small differences between the scanned image and the pristine image. It will also be apparent that the robustness of a particular characterizing algorithm can vary for different address blocks. (As a hypothetical example, the above described algorithm based on word length may be less robust for address blocks printed in a small font while algorithms based on the number of outliers, or address block shape may be relatively insensitive to font size.)

Please replace paragraph [0036] with the following amended paragraph:

**[0036]** At step 64, controller 13 inputs a print/scan filter which simulates the printing process of printer 14 and the scanning process to be carried out at a remote postal facility from data store 26 and applies it to image P to generate a filtered image, F, which approximates the image which will be scanned from the mail piece at the postal facility. And at step 66 sets index i equal to 1 and variable R equal to 0 and at step 70.

Please replace paragraph [0037] with the following amended paragraph:

**[0037]** ~~And step 66 controller 13 sets index i = 1 and variable R = 0, and at step at step~~  
70 applies the ith characterizing algorithm  $C_i$  to images P and F to generate corresponding descriptors  $C_i(P)$  and  $C_i(F)$ ; each comprising a sequence of M characterizations, or values,  $C_i(P)_1$  through  $C_i(P)_M$ ;  $C_i(F)_1$  through  $C_i(F)_M$ . Then at step 72, controller 13 compares

descriptors  $C_i(P)$  and  $C_i(F)$  to estimate a robustness value  $R_i$  for the  $i$ th algorithm  $C_i$ , with respect to a particular image  $P$ .